



# Nanotechnology: Achieving Leadership in Virginia

Presented to  
JCOTS Nanotechnology Advisory Committee  
*by*

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# Agenda

- Key Questions
- VNI “White Paper” Introduction
- Competitive Landscape
- VNI Update
- Discussion



# Key Questions

Can Virginia establish leadership in nanotechnology?

- What are the opportunities?
- What is the competitive landscape?
- What are nanotechnology's influencing factors?
- Does leadership require public sector involvement?
- What levels of government? Federal / State / Local
- What do we need?
- What should we do and when?
- What are the consequences of inaction?
- What are the benefits of strategic actions?



# The Next Scientific/Industrial Revolution

*“Investments in nanoscale science and technology research and development are essential to achieving the President’s top three priorities: winning the war on terrorism, securing the homeland and strengthening the economy.”*

- John Marburger, Director, Office of Science and Technology Policy, White House, 2003

- Defense
- Homeland Security
- Health Care
- Information Technology
- Transportation
- Civil Infrastructure



# Nanotechnology - Economic Opportunity

- Estimated world market by 2015: \$1 trillion
- Projected U. S. jobs by 2015: 800,000 – 900,000
- > \$8.6 billion to be invested worldwide in research in 2004
  - \$4.6B by national & local governments
  - ~ 1200 startup nanotech companies\*

Projected Virginia jobs by 2015: 50,000



# Recognized Challenges

- 1) Need to manufacture nanomaterials in sufficient volumes and affordable prices

“The DOD should make investments in research leading to new strategies for the processing, manufacture, inspection and maintenance of materials and systems.”

- National Research Council, 2003

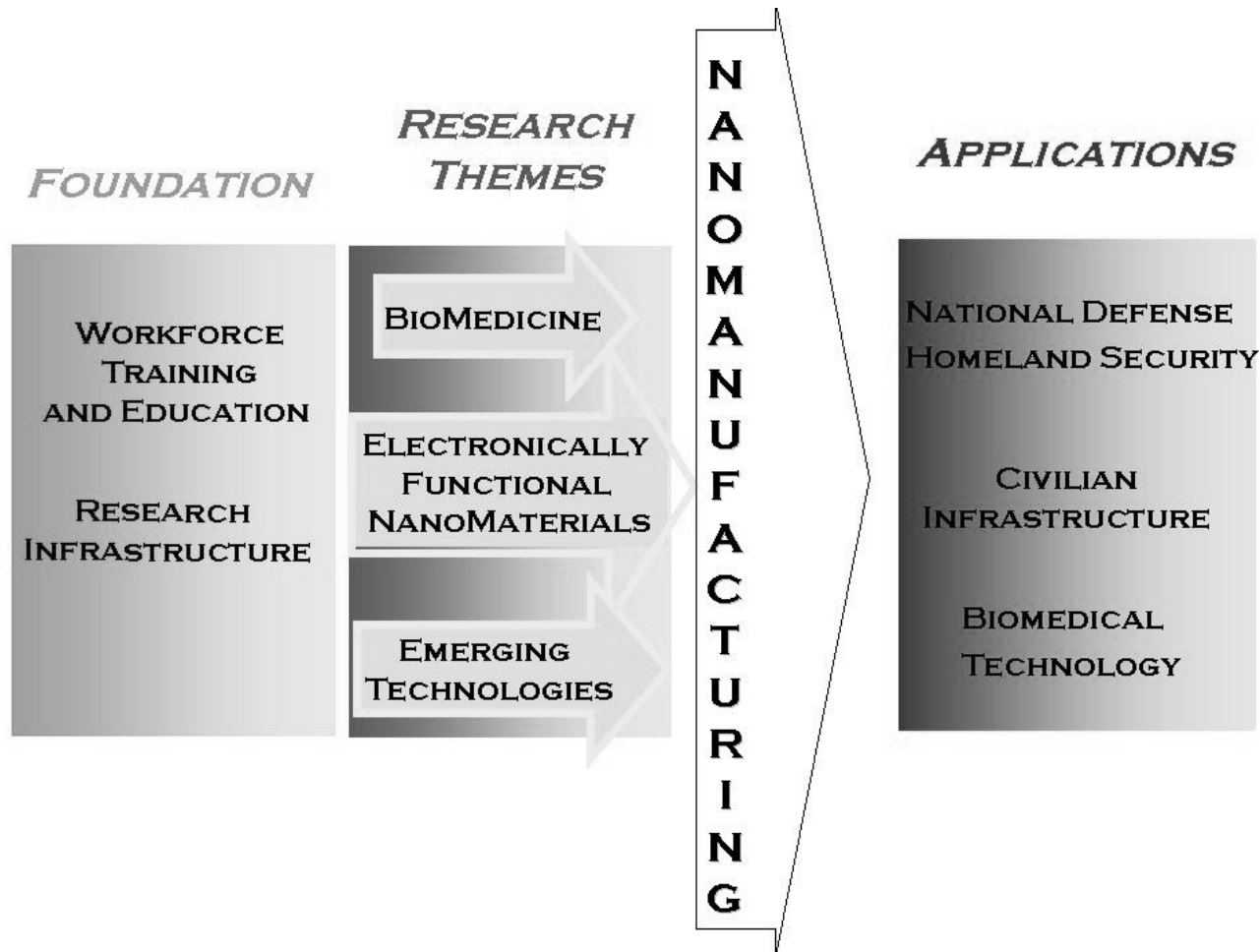
- 2) Need to develop a trained nanomanufacturing workforce

“Developing a broadly trained and educated nanotechnology workforce presents a severe challenge to our educational institutions, which favor compartmentalized learning.”

- National Science Foundation, 2001

# Nanomanufacturing: Key to the Nano Revolution

*The missing link between research and applications:*





# Nanotechnology Capabilities

# Modeling and Simulation

# Nanomaterials design and fabrication

## Characterization

# Electronically functional materials

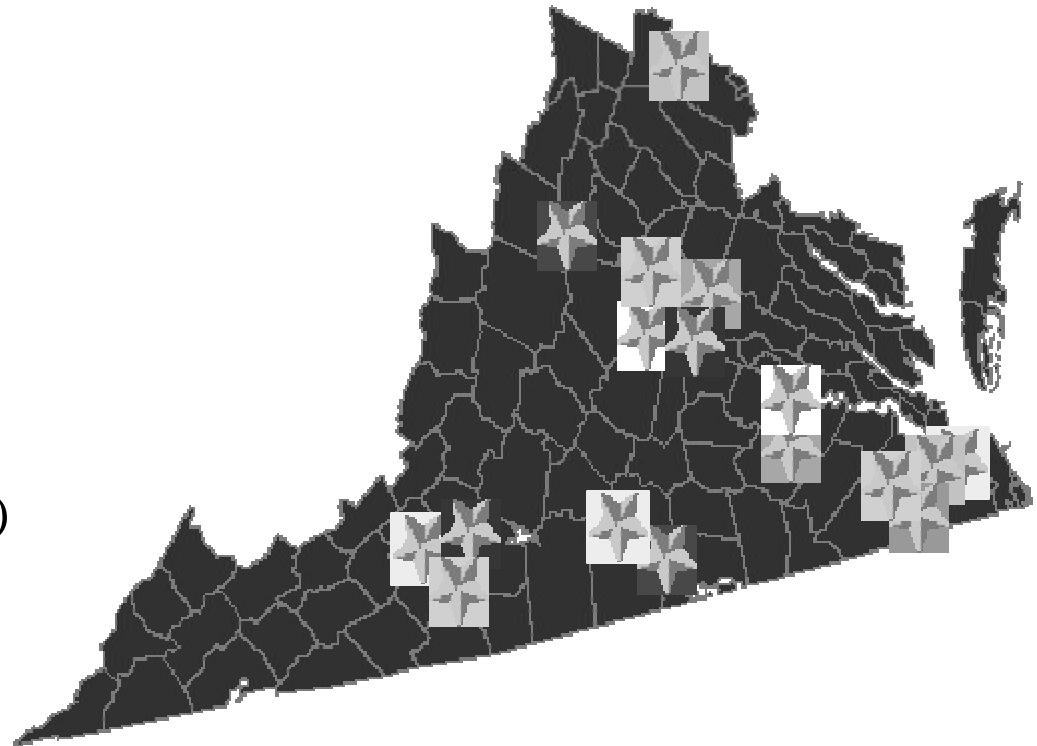
# Carbonaceous nanomaterials

## Emerging Technologies (fuel cells, quantum computing)

# Nanobiomedicine

# Nanomagnetics

## Workforce Development







# Virginia Assets - Academia

The College of William & Mary

Eastern Virginia Medical School

George Mason University

Hampton University

James Madison University

Norfolk State University

Old Dominion University

University of Virginia

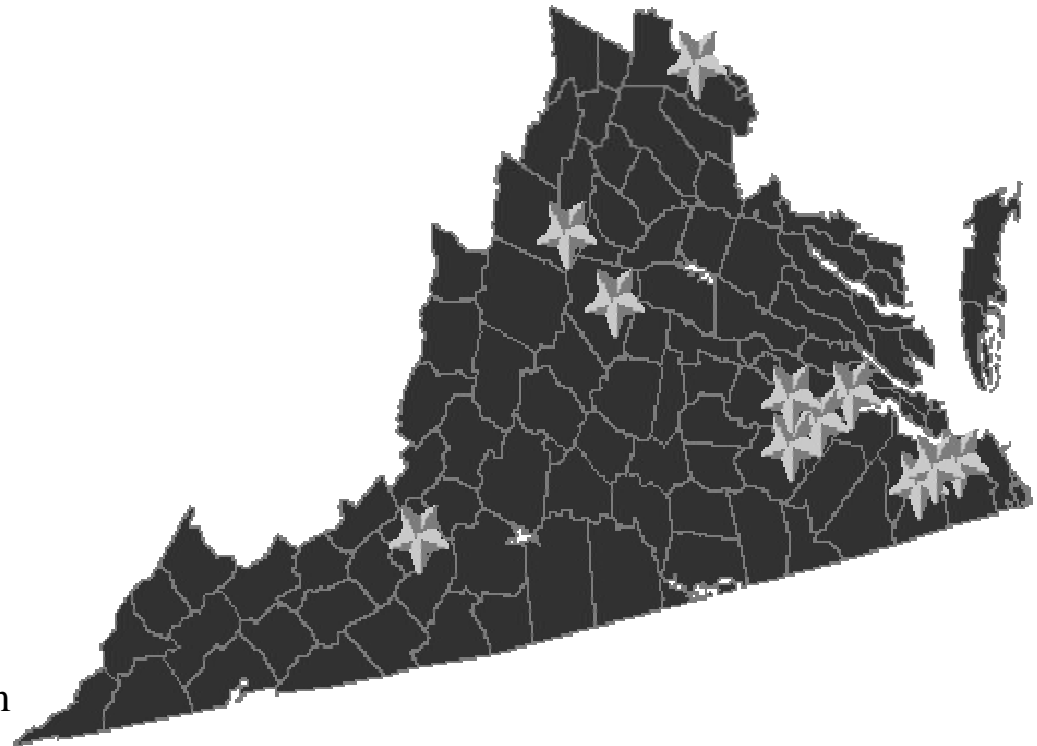
Virginia Commonwealth University

Virginia State University

Virginia Tech

K-12

Virginia Community College System



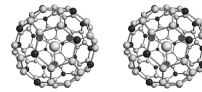
# Nanomanufacturing Expertise

- Nanomanufacturing facility in Danville

- Luna Innovations

- BioMedicine

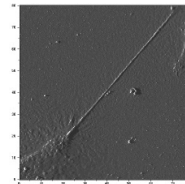
- Production and functionalization of fullerenes
- Electrospinning bio-scaffold materials
- Integrated biochips for biodefense



Trimetaspheres,  
Dorn et al (VT)

- Electronic Nanomaterials

- Carbon nanotubes production with FEL
- Nanofabrication and assembly
- Molecular architectures



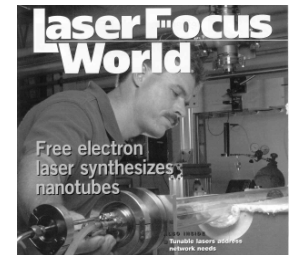
Nano-particles  
for Neurosurgery,  
Wnek et al., (VCU, UVA)

- Emerging Technologies

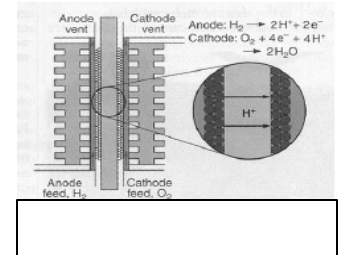
- Membranes and catalysts for fuel cells
- Adaptive nanostructured coatings



Biochips: Guiseppi, Landers,  
et al., (VCU, UVA, VSU)



CNTs with FEL,  
Holloway (W&M, JLAB)



Nanostructured  
Catalysts & membranes,  
McGrath et al (VT)



# Competitive Landscape



# International Competition

- Leadership up for grabs among EU, Japan, US
- Government Research Investments in 2003\*
  - USA - \$774 M
  - Western Europe – ~ \$650 M
  - Japan – ~ \$800M
  - Other – ~ \$800M
- > 30 countries have national nano activities
- Japan – focus on product development



# Private Investment

- Venture Capital
  - \$325M invested in nano in 2003
    - \$79M in Q1-2 2004
    - 1.6% of VC funding
- VC Hubs: Silicon Valley, Boston, Texas
- 5 Top Startups received ~ 22% VC investment
  - 3 California
  - 1 Texas
  - 1 Japan



# Private Investment

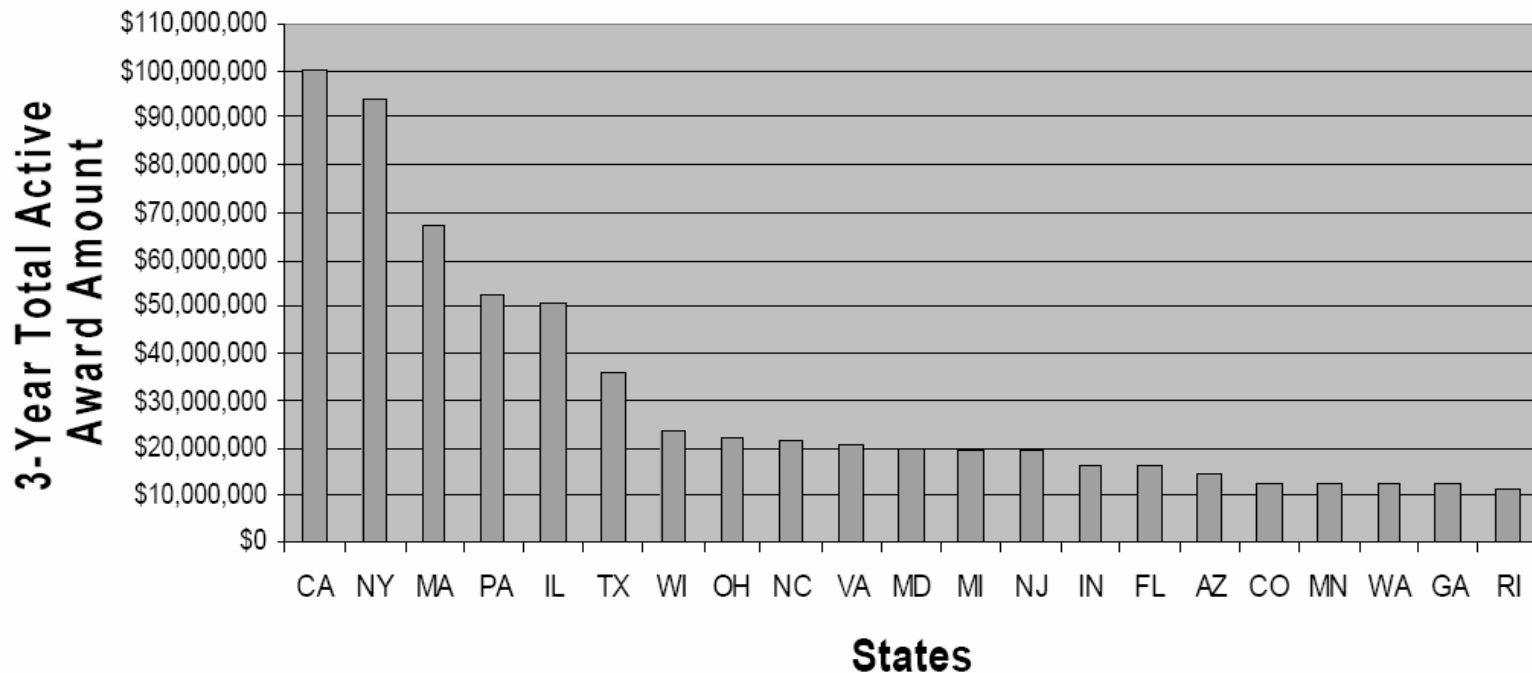
Where is the money being invested?

- 41% electronics and semiconductors
- 40% nanobiotechnology
- 14% specialty chemicals and nanomaterials
- 5% capital equipment and instrumentation

These are areas of strength for Virginia.

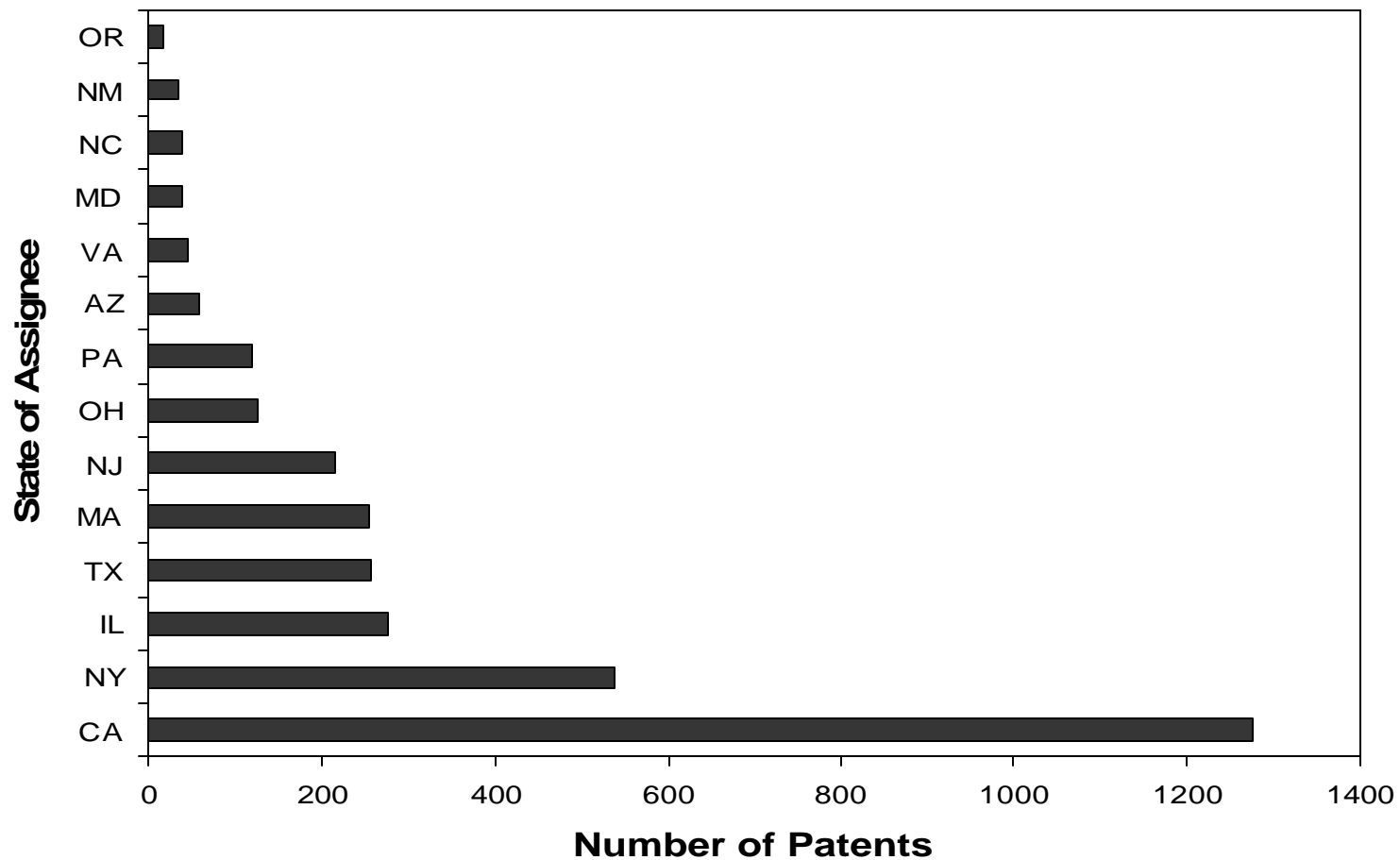
# Federal Research

## States with ACTIVE NSF-Supported NNI Research Awards Totaling \$10 million or more during FY 2001-2003



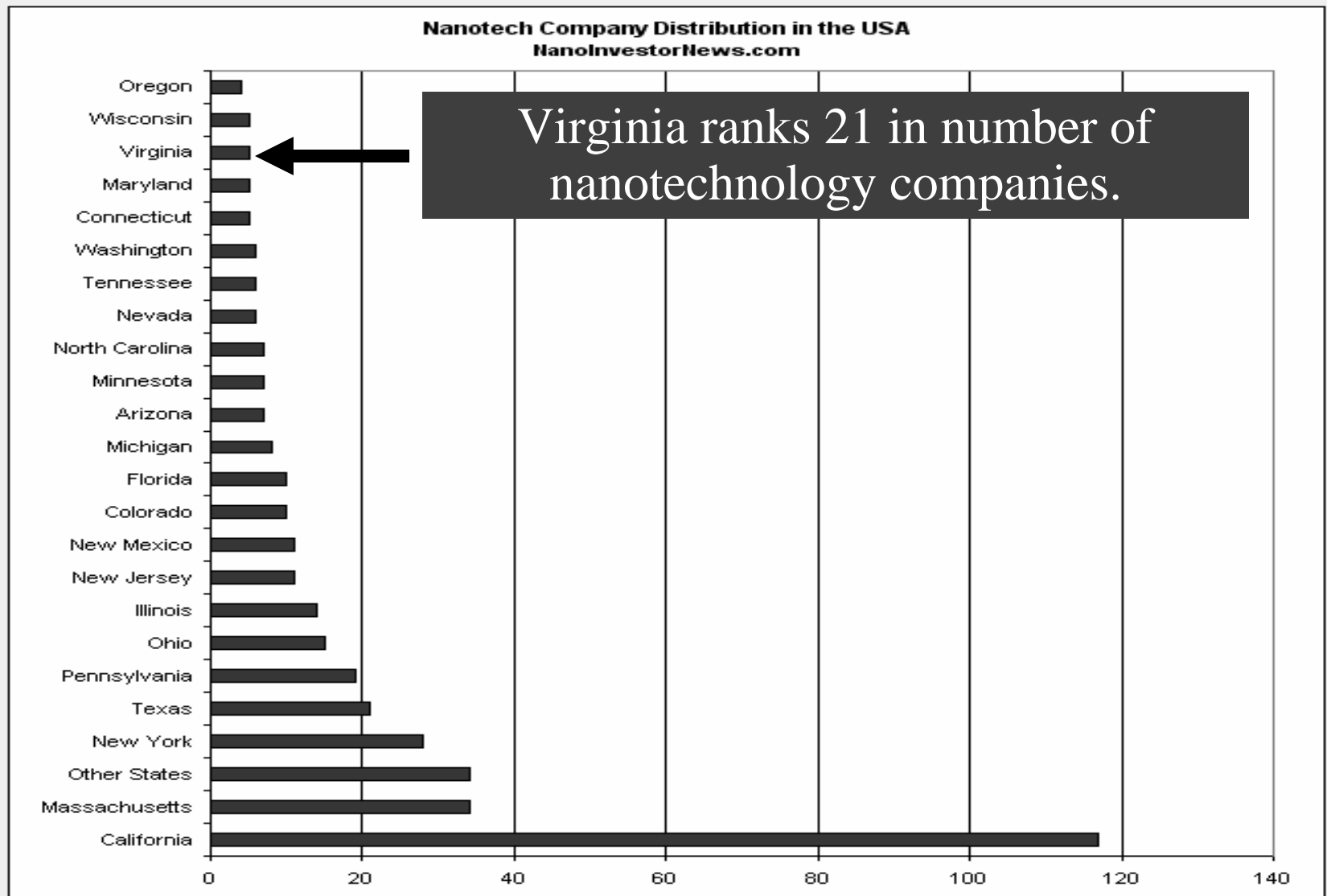
# Intellectual Property

## "Nano" Patents Assigned 1976 - 2004





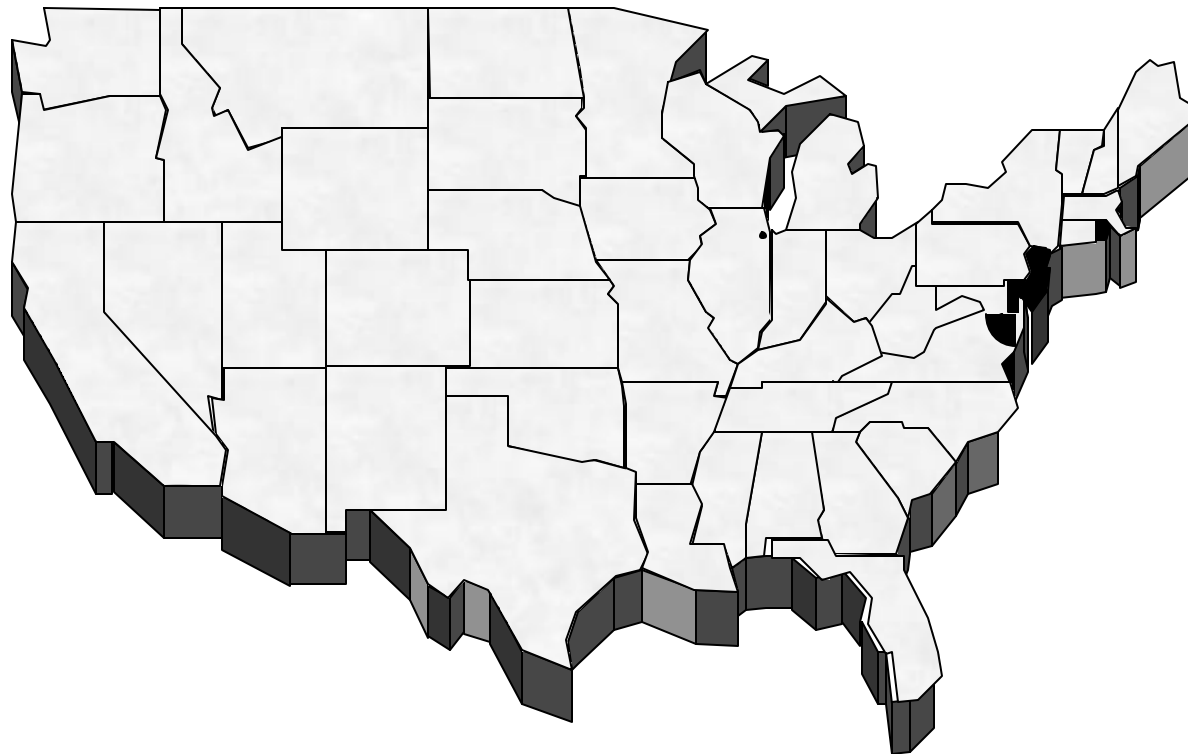
# Corporate Activity



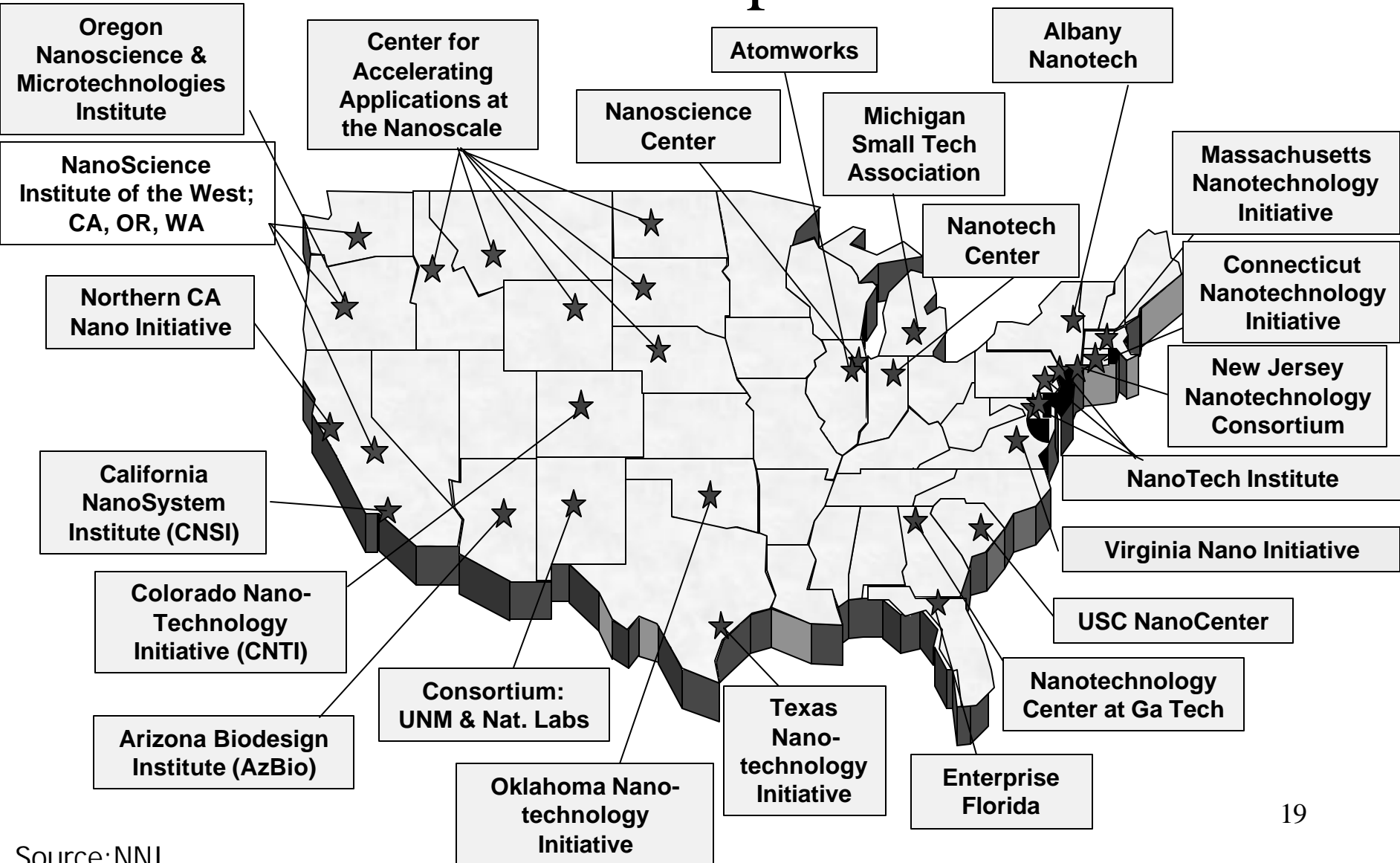
Source: Nanoinvestornews.com, April 2004



# Role of State Investment



# U.S. Competition





# State Investments in Nanotechnology

State	Recepient	Description	Commitment	Initiative Model
AZ	Nano-bio research center	Research Infrastructure	\$5M/yr for 20 yrs	University-state partnership
CA	California Nanosystems Institute	Building Infrastructure	\$100M over 4 yrs	Metropolitan-state
IL	Nanoscience Centers (NU, U IL, ANL)	Building & Research Infrastructure	\$63M	ATOMWORKS Metro-regional partnerships
NY	Nanoelectronics Center, Albany	Building & Research Infrastructure	\$50M (initial), \$400M over 5 yrs	University-state partnership
OR	ONAMI – Oregon Nano-Micro Interface Institute	Research Infrastructure	\$20M over 5 years	University-industry partnership
PA	Nanotechnology Center		\$37M	BFTP & Penn State NMT
TX	Four Universities: Rice, UT Dallas	Federal Earmark for SPRING Initiative	\$10M federal, 0.5M private	Corporate venture



# VNI Update



# 2004 Virginia Nano Highlights

- Luna announces Danville facility
- MITRE's Ellenbogen named "Top 5" in nanowires
- NanoSonic in "The Economist"
- LuxResearch names UVA in nano report
- VA's nano initiative cited in NNCO report
- CIT's GAP investment in 4Wave, Inc.
- Inventory of Nano Assets
- Virginia Nanotechnology Initiative



# Leadership in Nanomanufacturing

Mission: Attain a leadership position for Virginia in the cost effective manufacture of nanomaterials

## Foundation

- Collaborative research
- Users network
- Workforce development



# Recommended Investment Plan

Year	Amount	Allocation (est.)
1 @ \$40M	\$ 40M	\$15M Equipment \$24M R&D \$1M Workforce
2-5 @ \$25M/Yr	\$100M	
5 Year Total	\$140M	





## Summary

- Virginia can be a leader in nanomanufacturing
- Jobs and companies will be created
- State's role in seed funding and collaboration is vital
- Time is of the essence



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